Enticing Optical Elements Based on Unusual Index Photonic Crystals

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In this work we Investigate optical elements, In particular efficient lenses based on Photonic Crystals (PC) with an unusual Index of refraction, I.e. $n_{eff} < 1$ [1,2]. A concave lens consisting of an optimized periodic arrangement of alumina rods was built and measured In the microwave range, $f \in [6.5GHz;10GHz]$. Measurements In the TE and TM mode at many frequencies reveal good to excellent focusing Particular good focussing with Intensity gains as high as 35 for TM polarization and 11 for TE polarization could be found In regions with negative Index, I.e. $n_{eff} < 1$ [2] In full agreement with theoretical predictions.

The work Is extended to disordered structures, and other optical elements. As predicted by theory, deviations from strict periodicity of up to 30% should not destroy the focusing effect and this Is born out In experiments. Guided by theory, different variants of the concave lens and other structures were built and tested, with the goal of producing devices like beam splitters, filters, etc. The resulting structures can be easily scaled to other frequency regions, e.g. for applications In the emerging THz bands.

[1] V.V. Sergentu *et al.*, Phys. Stat. Sol. (a) 201, R31 (2004)
[2] E. Foca *et al.*, Phys. Stat. Sol. (a) 202, 4, R35-R37 (2005).